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ABSTRACT

This paper presents a study of factors influencing students' perceived learning in a World Wide Web-based course environment. Qualitative and quantitative methods were employed in the process of data collection and analysis. Results indicated that percent of grade weight on discussion and instructor's specification of requirements of students' contributions in discussion were significantly and positively correlated to students' perceived amount of learning. Although level of instructor's participation was not significantly correlated with students' perceived amount of learning, it had a significant correlation with level of students' participation. These findings indicated that students' perceptions of learning in Web-based courses varied positively with the degree of instructional emphasis on learning through interaction. They seemed congruent with the constructivist view that students learn better through social construction of meaning and that, in a constructive environment, the instructor's role has transformed from an authoritative figure into a facilitator providing scaffolding and support during the learning process. Several tables and charts present data. Appendices include a list of SLN (State University of New York Learning Network) Web-based courses, survey questions selected for the correlational analysis, and a table of demographic variables and students' perceptions of the learning experience. (Author/AEF)

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Paper for AERA 98 (San Diego)

Course Design, Instruction, and Students' Online Behaviors

A Study of Instructional Variables and Students' Perceptions of Online Learning

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Abstract: The paper was a study of factors influencing students' perceived learning in a Web-based course environment. Qualitative and quantitative methods were employed in the process of data collection and analysis. Results indicated that percent of grade weight on discussion and instructor's specification of requirements of students' contributions in discussion were significantly and positively correlated to students' perceived amount of learning. Although level of instructor's participation was not significantly correlated with students' perceived amount of learning, it had a significant correlation with level of students' participation. These findings indicated that students' perceptions of learning in Web-based courses varied positively with the degree of instructional emphasis on learning through interaction. They seemed congruent with the constructivist view that students learn better through social construction of meaning and that in a constructive environment, the instructor's role has transformed from an authoritative figure into a facilitator providing scaffolding and support during the learning process.

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1. Introduction

Two factors are currently impacting higher education: 1) With the advancement of technology, the conversion of traditional courses into Web courses is becoming increasingly easier and occurring more systematically in higher education. 2) A growing demand for continuing education is dramatically changing the demographic structure of college student population, with more and more students working full time and carrying family responsibilities. These two factors are making Web-based courses desirable and easy to implement. However, since it is a new medium for course delivery, we do not yet know what factors in the online environment contribute more to students' learning. With a prospect of more Web-based courses impacting an increasing number of students, it is imperative to gain a better understanding of online courses to improve instruction and students' learning. As a result, this year long study was conducted to examine relationships between instructional variables and students' perceptions of learning experience in nineteen Web-based courses delivered in the spring of 1997 through the State University of New York Learning Network (SLN). This paper reports findings from the first part of the study.

2. Background

In a constructivist view, learning is an active process in which the learner is building on an ongoing basis an internal representation of knowledge, a personal interpretation of experiences. This representation is constantly open to change, its structure and linkages forming the foundation to which other knowledge structures are appended (Bednar et al., 1992; Cunningham, Donald, 1992). According to Fosnot (1992), "the process of construction is more like the process of inventing, or at least re-inventing, in that it is akin to the creative process. It requires the reorganization of old 'data' and the building of new models for that learner. Thus the development of the idea, the progressive ordering and reordering, is of prime importance -- and indeed is the essence of constructivism." (p. 169) Cognitive development "comes from the sharing of

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multiple perspectives and the simultaneous changing of our internal representations in response to those perspectives as well as through cumulative experience." (Bednar et al., 1992, p. 21)

Based on the constructivist views, the overarching goal of instruction should be to move the learner into thinking in the knowledge domains as an expert user of that domain might think, rather to organize knowledge into discrete facts and propositions in an hierarchical order and expect students to receive them passively. It is the process of constructing a perspective or understanding by the learner that is essential to learning; no meaningful construction (nor authentic activity) is possible if all relevant information is prescribed (Bednar et al., 1992). Thus, an important element in instruction is to provide an environment for students to interact and collaboratively construct meaning.

Many researchers believe that the online classroom provides a many-to-many environment (Harasim, 1990) which can best support construction of meaning (Keye, 1992). Through collaborative online learning, students can share unique experiences of a diverse nature. The various perspectives that emerge during online discussion clarify and illuminate learning for all members in the class. Thus, theoretically, an online environment is claimed to support this process of construction of meaning and sharing of multiple perspectives through online discussion. However, review of literature reveals that there are no empirical studies of multiple courses delivered entirely online to support this claim.

To date, most research has concentrated on describing the characteristics of computer conferencing including advantages and disadvantages (Bellman, 1992; Berge & Collins, 1995a, 1995b, 1995c; Eastmond, 1995; Harasim, 1990a; Hiltz and Turoff, 1978a; Hiltz, 1994; Mason, 1990, 1993a; Mason & Kaye, 1989; Turoff, 1995; Wells, 1993). Some research studies stopped with quantitative analyses of computer conferencing messages sent and by whom, number and time of logons, and message maps showing the number of replies and message chains (Mason, 1992a). Others (Henri, 1992; Eastmond, 1995; Newman et al., 1995; Berge, 1997) focused more on qualitative analysis of students' messages and what critical skills manifested in those messages.

In his review of computer conferencing in the online classroom, Berge (1997) concludes that there has been little research on instructional design issues except that of Burge and Roberts (1993), Eastmond and Ziegahn (1995), and Nalley (1995). Burge and Roberts (1993) offer a practical guide to the use of computer conferencing technologies; Eastmond and Ziegahn (1995), based on their experience in designing an adult course, outline essential issues, considerations, and tasks for instructional development with computer-mediated communication (CMC). Nalley (1995) describes the instructional design process of how to incorporate CMC into two existing courses and offers some practical guidance in instructional design. These three studies, with their valuable insights into design issues, were not based on empirical data. Berge (1997) suggests that researchers should now turn their focus in a different direction, for example, to find how computer conferencing is integrated into the overall course and program, or what group sizes and what conditions would be best in which computer conferencing settings? This study, very much in line with Berge's suggestions, was designed to find out what instructional factors influence students' perceptions of learning experience in Web-based course environments.

The research questions for this first part of the study were as follows:

1. Do demographic variables influence students' perceptions of learning experience in Web-based courses?
2. What instructional variables are significantly related to students' perceptions of learning experience in Web-based courses?
3. Does class size influence students' perceptions of learning experience?

3. Methodology

The study used survey data and course data collected from the first nineteen Web-based courses delivered through the State University of New York Learning Network (SUNY Learning Network or SLN) in the spring of 1997. The survey and course data were all in digital format (see descriptions below).

The Participants

The participants (N = 183) were students enrolled and finished in the spring of 1997 SLN Web-based courses. Data were not collected from students who enrolled but did not complete their course. Students registered for these courses through the participating SUNY colleges on the project, two four-year colleges and six two-year community colleges. Thirty eight percent of the participants were full-time students and the rest were part-time students. Fifty-two percent were working full time, twenty-nine percent working part-time, and nineteen percent not employed. Sixty percent of the students were female and forty percent male. Their ages ranged from 21 to over 50. Thirty-eight percent of the students were 21 to 30 years old, twenty-three percent 31 to 40, twenty-two percent 41 to 50, and thirteen percent 51 and older. The demographic information is summarized in Table 1. Demographic Information.

Table 1. Demographic Information

Matriculation	Employment	Age	Gender
Full-time = 38%	Full-time = 52%	21 - 30 = 38%	Female = 60%
Part-time = 62%	Part-time = 29%	31 - 40 = 23%	Male = 40%
	Not working = 19%	41 - 50 = 22%	
		51 - older = 13%	

Design

The study used participant observation, survey technique, and correlational analysis. The researchers were directly involved in the development and delivery of the courses, providing technical and instructional support. In this role they had direct access to the course data in digital records. During course delivery the researchers, while collaborating on the design of online surveys, closely observed the courses to see if there were any factors that might have some influence on students' online behaviors. Students were noticed to be more active in some courses than in others. At the end of the semester, three types of data were collected:

A. Five dependent variables were obtained from the survey and course data

Since these courses were in different subject areas (see Appendix A: SLN Web-based Courses of Spring 97) and at different levels, it was not possible to use a generic instrument to measure students' learning achievement. Thus, survey data were used for this study. The five dependent variables were:

1) perceived amount of learning -- a quantitative summary of students' answers to the selected survey question on learning achievement (Question 3 in Appendix B: Survey questions selected for the correlational analysis)

2) perceived degree of interaction with instructor -- a quantitative summary of students' answers to the selected survey question on interaction with their instructor (Question 2 in Appendix B: Survey questions selected for the correlational analysis)

3) perceived degree of interaction with fellow students -- a quantitative summary of students' answers to the selected survey question on interaction with fellow students (Question 1 in Appendix B: Survey questions selected for the correlational analysis)

4) students' perceptions of learning experience -- a quantitative summary of students' answers to the selected survey questions on learning achievement, interaction with their instructor and fellow students (Questions 1, 2, 3 in Appendix B: Survey questions selected for the correlational analysis)

5) number of students' responses -- a raw count of student's responses divided by number of students in each course. This indicated level of student's participation in discussion.

B. Five instructional (independent) variables were identified:

a. percent of grade weight on discussion -- percent of course grade weight assigned to students' participation in discussion

b. percent of grade weight on written assignments -- percent of course grade weight assigned to written assignments

c. specification of requirements of discussion -- the expressed quality and quantity specification of requirements of students' contributions in discussion

d. number of instructor's responses per student -- a raw count of instructor's responses divided by number of students' in each course. This indicated level of instructor's participation in discussion.

e. class size -- number of students who completed the course. Class size was a quasi-independent variable in that it was controlled by some but not all instructors in the SLN courses.

C. Demographic information

Three demographic variables were identified: gender, age, and employment status.

Correlational analysis was conducted to see if the instructional and demographic variables were significantly correlated to students' perceptions of learning experience.

Procedure

Data consist of three types: demographic information, survey data, and course data.

1. Collection of Demographic information

Demographic information (gender, age, and employment) was obtained through the SLN Web Account Request form that each enrolled student was required to fill out for a password to access their courses. We predicted that female students, older students, and students working full-time would find the online courses more facilitative to their learning based on the belief that an asynchronous learning environment is time and place independent and can accommodate students' family and work responsibilities.

2. Collection of survey data

In the fall of 1996, a survey was designed for a pilot study and sent out to students enrolled in one online course, *Child Development and Psychology*, offered in SUNY New Paltz. The purpose of this survey was to find out students' perceptions of learning and degree of interaction with the instructor and fellow students in this online course. Based on the ten responses (Total number of enrolled students = 13), the survey was revised and was then sent to all the course instructors of the Spring 97 term and other distance and online education experts for review on its content validity and was revised again based on their feedback and suggestions. In may 1997, the survey was administered online to all the SLN students registered for the Spring 97 term. Students filled out and submitted the survey through the World Wide Web. Online surveys saved postal delay, cost, and the labor of data entry.

Altogether 183 students enrolled and finished their courses and 109 responded to the survey with a response rate of 60%. Of the 109 respondents, seven were enrolled in two courses and only one of the seven submitted a survey for each of the courses the student was taking. It was not possible to classify the other six students into any one course. Therefore only 103 students were included in the study. Three multiple-choice questions from this survey were selected for this study (See Appendix B: Survey questions selected for correlational analysis). These questions focus on students' perceived amount of learning and degree of interaction with the instructor and their fellow students.

3. Collection of course data

The term *course data* refers to course documents in digital format. Course documents consist basically of: a. orientation and syllabus; b. content presentations such as mini-lectures; c. reading assignments; d. written assignments; e. instructor's discussion questions; f. responses from students and the instructor; g. documents in other areas such Bulletin Board, Shared references, etc..

As participant observers and instructional designers, the researchers had direct access to the course data. Consent was obtained from the instructors and students to include their courses in our study. Through close observations, several interesting factors were believed to be influencing students' online behaviors.

Factor one: percent of grade weight on discussion. Eighteen out of nineteen courses incorporated a class discussion for students' interaction. However, each course assigned different grade weight to discussion ranging from 0% to 50%. Although each course required students to complete several written assignments, these assignments were mostly submitted to the instructors and visible to the individual student and the instructor only. The discussion area, however, was a public domain where all the members of a class came together sharing opinions and experiences. - Therefore, it was predicted that the amount of required discussion in a course would be related to students' perceived amount of learning, while the written assignments would not. The prediction was based on the constructivist view that students learn better through social construction of meaning.

Factor two: the instructor's specification of quality and quantity requirements of discussion. Corresponding to percent of course grade assigned to participation in discussion were the quantity and quality requirements of students' contributions to discussion by the instructor such as number of contributions, correct use of grammar. It was predicted that the specification of quantity and quality requirements of students' contributions to discussion would be related to students' perceived amount of learning.

Factor three: number of instructor's responses per student. It was noticed that the number of instructor's responses in the discussion area varied. According to the constructivist view, the role of an instructor is that of a facilitator, rather than an authoritarian figure transmitting knowledge. Thus, it was predicted that number of instructor's responses per student in discussion would not influence students' perceptions of learning experience.

Factor four: class size. The number of students for who completed the SLN course was obtained from each course. According to Berge (1997), so far no research has shown what class size is the optimal

number for an online course. The assumption was that class size in a certain range of 4 to 25 (based on the class sizes of the 19 SLN courses) would not influence students' perceptions of learning experience since this was asynchronous learning and everyone had an equal opportunity to interact with fellow students and the instructor.

Factor five: number of responses produced per student. A raw count of responses produced by student was obtained and divided by number of students in the course to obtain the average number of responses produced per students. Although this was a variable that could be affected by instructional variables, it was included in the analysis to show if the number of responses produced per student was related to any instructional variables or to students' perceptions of their learning experience.

Along with the above five factors, three key items were selected from the survey that focused on students' perceptions of their learning experience (See Appendix B: Survey questions selected for the correlational analysis).

Limitation of the study

Since this study was based on students' perceptions of learning experience, the researchers did not know how those students who did not respond to our surveys or officially dropped out thought about the online courses and what were their problems. Though this is an area to looked into in the near future, any findings from this study only apply to those students who responded to the survey.

Data Analysis

Research Question 1: Do demographic variables (age, gender, and employment) influence students' perceptions of learning experience?

Demographic information for gender, age, and employment was tabulated along with the quantitative summaries of students' answers (using individual student as unit) to the three multiple-choice questions on learning and interaction (See Appendix C. Demographic variables and students' perceptions of learning experience). Correlational analysis was run to see if students' demographic variables had any relation with their perceptions of learning experience.

Research Questions 2: What instructional variables are significantly related to students' perceptions of learning experience?

The course was used as a unit to answer this question and seventeen out of nineteen courses offered in the Spring 97 term were included in this part of analysis. The data for one course was found to be an outlier in our scatter plot; the number of instructor's responses per student in this course was 66, which was 60 responses higher than the mean (5.6 responses) for all the other courses (not including this course). Another course did not require online discussion and no students from this course responded to the survey. Therefore these two courses were not included in this part of the study.

Answers to the two of the three selected survey questions (see Appendix B: Survey questions selected for the correlational analysis) were of three-point Likert-scale: more, same, less (3, 2, 1 were used to represent the values). One question used five-point Likert-scale: much more, more, same, less, much less (5, 4, 3, 2, 1 were used to represent the values). The mean of each item was calculated for each course for correlational analysis.

Research Question 2 was broken down into four parts corresponding to the four identified instructional variables:

1) Is percent of grade weight on discussion related to students' perceptions of learning experience?

Percent of grade weight on discussion and survey data were used to answer the question. The class means of students' answers to the three survey questions were tabulated along the percent of grade weight on discussion for each course. Correlational analysis was run to see if there was any significant correlation between percent of grade weight on discussion and students' perceptions of learning experience.

2) Does the instructor's specification of requirements for participation relate to the students' perceptions of learning experience

Data on the instructor's specification of requirements for participation and survey data were used to answer this question.

Each course contained an orientation document outlining instructor's expectations from students. Many instructors included expectations about the quality or quantity of student participation in online discussion. Six levels of instructor's requirements of students' contributions in discussion were identified from the courses: 1) General mention of quantity of contributions; 2) Requirement of timeliness of contributions; 3) General mention of quality of contributions; 4) Specific requirement of number of contributions; 5) Specific requirement of quality of contributions. A numerical value was assigned to each course by giving one point for each level addressed by the instructor. If an instructor mentioned all the five requirements, the course would be given five points. If an instructor made a brief mention of quantity and quality requirements without making any further specification of quantity and quality requirements, the course would be assigned two points. If an instructor required discussion but did not mention any of the five requirements, it received a 0 point. Thus, instructor's specification of requirements of discussion of the 17 courses was rated on a 5-point scale with 0 as the lowest and five as the highest of requirements. The rating of requirements for a course was tabulated along with the means of students' answers to the three multiple-choice questions. Correlational analysis was run to see if there was any significant correlation between the instructor's specification of requirements for participation and students' perceptions of leaning experience.

3) Is percent of grade weight on written assignments related to students' perceptions of learning experience?

Percent of grade weight on written assignments and survey data were used to answer the question. The class means of students' answers to the survey questions were tabulated along with percent of grade weight on written assignments for the courses. Correlational analysis was run to see if there was any significant correlation between percent of grade weight on written assignments and students' perceptions of learning experience.

4) Is number of instructor's responses per student related to students' perceptions of learning experience?

Number of instructor's responses per student and survey data were used to answer this question. Number of instructor's responses per student was the raw count of an instructor's total responses in the discussion area divided by number of active students in the class. Number of instructor's responses per student for the seventeen courses was tabulated along with the means of students' answers to the three survey questions. Correlational analysis was run to see if there was any significant correlation between number of instructor's responses per student and students' perceptions of learning experience.

Research Questions 3. Does class size influence students' perceptions of learning experience?

Number of students in a course was tabulated along with the means of students' answers to the three multiple-choice questions. Correlational analysis was run to see if there was any significant correlation between them.

4. Results

1. Demographic information and students' perceptions of learning experience

Table 1 summarizes the results of the statistical analysis of the correlation between participants' demographic information and students' perceptions of learning experience.

Table 1. Correlation of students' perceptions of learning experience with participants' gender, age, and employment status

	Gender	Age	Employment
	r	r	r
Am/Ln	-0.04	0.18	0.03
Inter/IS	0.08	-0.06	0.08
Inter/Ss	0.07	0.02	-0.02

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Am/Ln = students' perceived amount of learning

Inter/SS = students' perceived interaction with their fellow students

Inter/IS = students' perceived interaction with their instructor

Results of correlational analyses showed that there was no significant correlation between students' perceptions of learning experience and their gender, age, or employment status. This was contradictory to our prediction that female students, older students, and students working full-time would find that they have learned more in these courses. It seems that the SLN Web-based learning environment was equally satisfactory for all types of students.

2. Instructional variables and students' perceptions of learning experience

In this part of our analyses, we wanted to answer the following four questions:

1) Is percent of grade weight on discussion related to students' perceived learning experience?

2) Does the instructor's specification of requirements for participation relate to the students' perceptions of learning experience?

3) Is percent of grade weight on written assignments related to students' perceptions of learning experience?

4) Is number of instructor's responses per student related to students' perceived learning experience?

To answer these questions, we tabulated the data collected from the courses and from the survey in Table 2 and Table 3 and ran correlational analyses between them.

Table 2. Data from the seventeen SLN Web-based courses selected for correlational analyses

Course	GPDisc	RmtDisc	GPWritt	RSS	TNSS	Class/Size
1	5%	1	70%	2.5	10.75	4
2	25%	4	50%	18	36.5	6
3	0%	1	0%	2.3	31.17	6
4	20%	2	80%	1.2	32.1	10
5	40%	4	50%	1.5	18.18	11
6	40%	2	60%	1.7	28.46	13
7	35%	5	65%	9.1	53.35	17
8	20%	3	35%	2.1	12.2	9
9	35%	5	65%	5.3	34.6	15
10	40%	1	60%	14.5	59.82	11
11	20%	3	80%	10.4	26	5
12	50%	4	50%	3.18	42.91	11
13	30%	3	65%	1.7	22.45	11
14	20%	2	80%	1.5	16.3	20
15	50%	5	50%	10.2	54.17	6
16	20%	2	50%	8.9	46.14	7
17	20%	5	80%	1.7	33.39	23
Mean	28%	3	58%	5.63	32.85	10.88
Std. Dev	14%	1.58	20%	5.23	14.74	5.37

Note:

GPDisc = percent of grade weight on discussion

RmtDisc = expressed quantity and quality requirements of students' participation in discussion

GPWritt = percent of grade weight on written assignments

RSS = number of instructor's responses per student

TNSS = number of responses by each student

Table 3. Means of students' answers to the three survey questions

Course	Mean Am/Ln	Mean Inter/SS	Mean Inter/IS
1	2	1	1
2	2.25	1.75	2.25
3	1	1.5	2.5
4	1.5	2	1
5	2.67	1.5	2
6	2.1	1.7	1.3
7	2.43	2.14	2.57
8	2.12	1.13	1.63
9	2.25	2.25	2.25
10	2	2.5	3
11	3	1	3
12	2.71	2.29	1.57
13	2.13	1.75	1.13
14	2.25	1.88	2
15	3	3	3
16	2.4	2	1.8
17	2.8	2.1	2.5
Mean	2.27	1.85	2.03
Std. Dev	.51	.53	.69

Am/Ln = students' perceived amount of learning
Inter/SS = students' perceived degree of interaction with their fellow students
Inter/IS= students' perceived degree of interaction with their instructor

Results of the correlational analysis were summarized in Tables 4 through 7.

Table 4. Results of correlational analyses of instructional variables with students' perceptions of learning experience

	GPDisc			RmtDisc			GPWritt		
	r	partial r	R^2	r	partial r	R^2	r	partial r	R^2
Am/Ln	.56**	.54*	.29	.62**	.62**	.38	.43		
Inter/IS	.19			.22			-.12		
Inter/SS	.65**	.64**	.41	.42			.07		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Partial r is controlling for the effects of class size.

Table 4 reveals that percent of grade weight on discussion was significantly correlated with students' perceived amount of learning in these courses ($r = .56$, $p < .01$). Percent of grade weight on discussion was also significantly correlated with students' perceived degree of interaction with fellow students ($r = .65$, $p < .01$), though it had no significant correlation with students' perceived degree of interaction with the instructor ($r = .17$, $p > .05$).

Corresponding to the positive significant relation between percent of grade weight on discussion and students' perceived amount of learning, results also showed a significant correlation between requirements of discussion ($r = .62$, $p < .01$) and students' perceived amount of learning. A coefficient of determination of .38 indicates that 38% of the variance in the perceived amount of learning was accounted for by the variation in the requirements of discussion. No significant correlation was found between requirements of discussion and students' perceived degree of interaction with fellow students and their instructor.

Table 4 shows that percent of grade weight on written assignments has no significant relation with students' perceived amount of learning ($r = .43$, $p > .05$), nor with their perceived degree of interaction with fellow students ($r = .07$, $p > .05$) and the instructor ($r = -.12$, $p > .05$).

These findings support our prediction that percent of grade weight on discussion and the instructor's specification of quantity and quality requirements of students' participation in discussion would be related to students' perceived amount of learning, while percent of grade weight on written assignments would not.

Table 5. Results of correlational analyses of number of instructor's responses with students' perceptions of learning experience

	r	partial r	R^2
RSS - Inter/IS	.61**	.67**	.45
RSS - Am/Ln	.25		
RSS - GPDisc	.22		

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Partial r is controlling for the effects of class size.

The number of instructor's responses was significantly correlated with students' perceived degree of interaction with the instructor ($r = .61$, $p < .01$), but it was not statistically related to students' perceived amount of learning ($r = .25$, $p > .05$) nor to percent of grade weight on discussion ($r = .22$, $p > .05$). This was congruent with our prediction that number of instructor's responses per student in discussion would not be related to students' perceived amount of learning based on a constructivist view point. It is logical to think that the more an instructor responds, the more interaction with the instructor students would feel to have experienced. A high percent of grade weight assigned to students' participation in discussion does not necessarily entail more responses from the instructor.

3. Class size, number of responses by each students, and students' perceptions of learning experience

Data of these variables were tabulated in Table 2 and 3 above. Results were summarized in Table 6 and 7.

Table 6. Results of correlational analyses of class size, number of responses produced per student, and students' perceptions of learning experience

	r
CSz - Inter/SS	.32
CSz - Inter/IS	.07
CSz - Am/Ln	.17
Csz - RSS	-.33
Csz - TNSS	.04

Note: * p < .05, ** p < .01, *** p < .001.

Class size was found to have no significant correlation with students' perceptions of learning experience, number of instructor's responses per student, and number of responses produced per student. This seemed to support our prediction that class size would not influence students' perceptions of learning experience in an asynchronous environment. Since the range of the class size was 4 to 25 for this sample, we should not extrapolate the findings to mean that if the class size increases beyond this range, it will have no correlation with students' perceptions of learning experience.

Table 7. Results of correlational analyses of number of responses produced per student with students' perceived learning experience and number of instructor's responses per student

	r	partial r	R
TNSS - Inter/SS	.80***	.84***	.71
TNSS - RSS	.63**	.68**	.46
TNSS - Inter/IS	.55*	.55*	.30
TNSS - Am/Ln	.18		

Note: * p < .05, ** p < .01, *** p < .001. Partial r is controlling for the effects of class size.

As can be expected, number of responses produced per student in a course was significantly correlated to students' perceived degree of interaction with fellow students ($r = .80$, $p < .001$) and their perceived degree of interaction with the instructor ($r = .55$, $p < .01$). A coefficient of determination of .71 indicates that 71% of the variance in students' perceived degree of interaction with fellow students is accounted for by the variation in number of students' responses in the discussion area. Though Table 5 shows no significant correlation between students' perceived amount of learning and number of instructor's responses per student ($r = .22$, $p > .05$), we found a positive statistical relation between number of instructor's responses per student and number of responses produced per student ($r = .63$, $p < .01$). A coefficient of determination of .46 indicates that 46% of the variance in number of responses produced per student is accounted for by the variation in number of instructor's responses in the discussion area.

The insignificant correlation between class size and number of responses produced per student ($r = .04$, $p > .05$) further supports our finding that class size had no relation with students' perceived learning experience. In addition, the actual number of responses produced per student was found to bear no influence on students' perceived amount of learning ($r = .18$, $p > .05$).

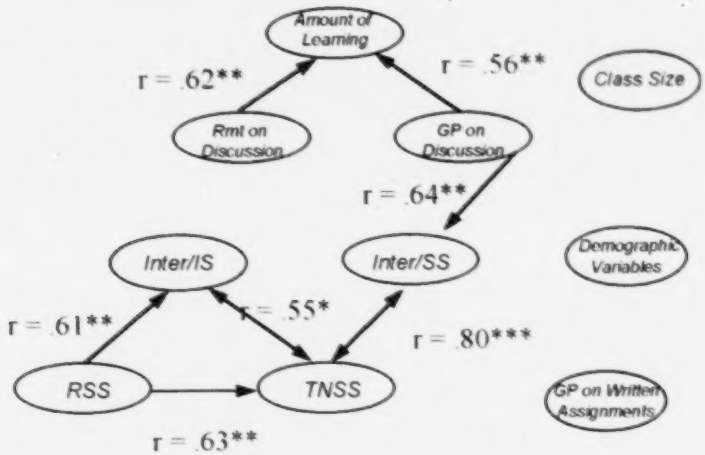
5. Discussion

A. Discussion based on our research questions for this study

1. Do demographic variables influence students' perceptions of learning experience in Web-based courses?
2. What instructional variables are significantly related to students' perceptions of learning experience in Web-based courses?
3. Does class size influence students' perceptions of learning experience?

To answer these questions, we created *Chart 1. Relations among identified variables* to show the relations among all the variables we identified for this study.

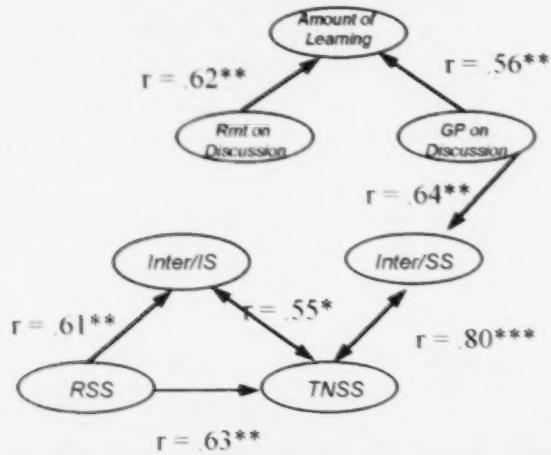
Chart 1. Relations among identified variables



Note: An arrow-headed line connects two variables that are statistically related. A one-directional arrow indicates relation between an instructional (independent) variable with a dependent variable. A bi-directional arrow indicates a relation between two dependent variables. Lack of an arrow-headed line between two variables indicates no statistical relation between the variables. The statistical relations in this chart were all positive.

Chart 1 shows that class size, demographic variables, and percent of grade weight on written assignments have no significant correlation with students' perceptions of learning experience. Thus, our answers to our first and third research questions are that students' perceptions of learning experience had no statistical relation with either demographic variables or class size. Therefore, we took these variables out together with percent of grade weight on written assignments and produced the following chart:

Chart 2. Correlation among instructional variables and students' perceptions of learning experience

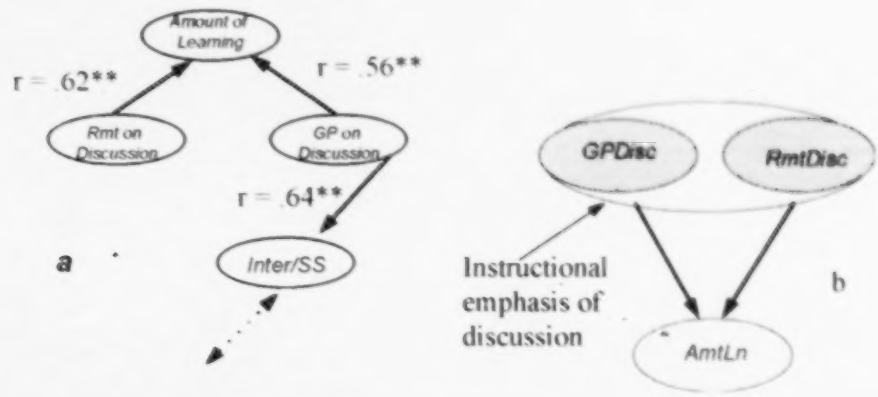


Note. An arrow-headed line connects two variables that are statistically related. A one-directional arrow indicates relation between an instructional (independent) variable with a dependent variable. A bi-directional arrow indicates a relation between two dependent variables. The statistical relations in this chart were all positive.

Chart 2 contains all variables found to have a significant relation with one another. A close examination of the chart reveals two interesting groups of variables centering on two main dependent variables: perceived amount of learning and perceived degree of interaction. They are represented by Chart 3 and Chart 4 respectively.

A. Chart 3a shows an open triangular relation among percent of grade weight on discussion, requirements of discussion (Rmt on Discussion), students' perceived amount of learning, and perceived degree of interaction with fellow students (Inter/SS). This open triangular group indicates that students' perceived amount of learning is statistically correlated with both percent of grade weight on discussion and requirements of discussion. These two instructional variables were determined by an instructor to ensure level of students' participation in discussion. They together expressed the instructional emphasis on discussion in a course. Chart 3b grouped these independent variables and indicated a tendency that the more students were required to be involved in discussion, the more they felt they had learned in the course. Since this is a correlational study, the finding does not indicate any causal effect relation; it indicates only a tight relation between the variables.

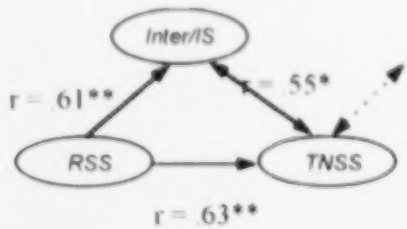
Chart 3. Relation between instructional requirements of discussion and students' perceived amount of learning



Note. An arrow-headed line connects two variables that are statistically related. A one-directional arrow indicates relation between an instructional (independent) variable with a dependent variable. A bi-directional arrow indicates a relation between two dependent variables. The statistical relations in this chart were all positive.

B. Chart 4 shows a closed triangular group of variables: students' perceived degree of interaction with instructor (Inter/IS), number of responses produced per student (TNSS), and number of instructor's responses per student (RSS). These variables were all significantly related with one another as is indicated in Chart 4 by the arrow-headed lines connecting the three variables. This closed triangular relation falls within our expectation. It seems reasonable to believe that the more the instructor responds, the more the students will respond, and the higher students' perceived degree of interaction with the instructor.

Chart 4. Closed triangular group of variables

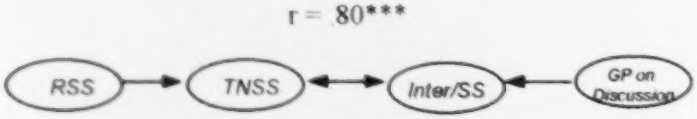


Note. An arrow-headed line connects two variables that are statistically related. A one-directional arrow indicates relation between an instructional (independent) variable with a dependent variable. A bi-directional arrow indicates a relation between two dependent variables. The statistical relations in this chart were all positive.

There is only one variable that connects the two groups represented by Chart 3 and 4: students' perceived degree of interaction with fellow students (Inter/SS) was significantly related to the percent of grade weight on discussion (GPDisc) and number of responses produced per student. Since one of our instructional goals was to create a student-centered environment, we were interested in interaction among students. Therefore, we took out the variable, perceived degree of interaction with instructor, and produced a linear

relation among the variables centering on students' perceived degree of interaction with fellow students (see Chart 5. Variables related to students' interaction).

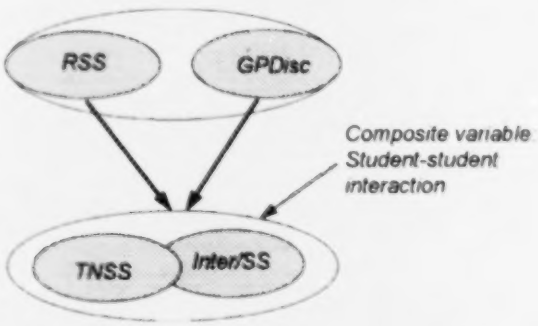
Chart 5. Variables related to students' interaction



Note: An arrow-headed line connects two variables that are statistically related. A one-directional arrow indicates relation between an instructional (independent) variable with a dependent variable. A bi-directional arrow indicates a relation between two dependent variables. The statistical relations in this chart were all positive.

Chart 5 shows two closely related variables: 1) the actual number of responses produced per student and the perceived degree of interaction with fellow students. Since these two variables were significantly related with each other indicating the perceived and the actual students' interaction, we combined the data of the two variables together to make a composite variable: student-student interaction. We ran partial correlational analysis of the composite variable with both number of instructor's responses and percent of grade weight on discussion. Results showed that student-student interaction was significantly correlated with number of instructor's responses ($r = .65$, $p < .01$) and with percent of grade weight on discussion ($r = .53$, $p < .05$).

Chart 6. Relation of student-student interaction with number of instructor's responses and percent of grade weight on discussion



Note: An arrow-headed line connects two variables that are statistically related. A one-directional arrow indicates relation between an instructional (independent) variable with a dependent variable. The statistical relations in this chart were all positive.

From the results of our analyses, we drew the following conclusions:

1) The two instructional variables, percent of grade weight on discussion and the instructor's specification of requirements of students' participation in discussion were statistically and positively related to students' perceived amount of learning;

2) Number of instructor's responses per student and percent of grade weight on discussion were statistically and positively related to student-student interaction.

3) Number of instructor's responses per student was statistically and positively related to students' perceived interaction with the instructor.

4) Class size and demographic variables were not significantly related to students' perceptions of learning experience

considered their learning more as a result of their own efforts than of their instructor's responses or instruction? Is it possible that students perceived the instructor's participation in discussion as motivating their participation? Is it possible that an online instructor responded to students more to organize or manage learning activities than to provide direct instruction? This is an interesting area that we will look into by in-depth content analysis of the courses.

Another interesting finding from the results is that since percent of grade weight on discussion is significantly correlated to students' perceived amount of learning, one would expect that the number of responses produced by each student in discussion should also be significantly correlated to students' perceived amount of learning. However, our findings showed the opposite: there was no significant correlation between these two. One possible explanation for this is that a high percent of grade weight assigned to students' participation in discussion might not necessarily increase the number of contributions to a significant extent but only ensure the required number and quality of students' contributions in discussion. Students might have spent more efforts on reading each other's contributions as well as course materials in order to understand the whole process and then to make more meaningful and constructive comments. Thus, it was not only the quantity but also the quality of responses that influenced students' perceived amount of leaning. This is only a speculation, an in-depth qualitative analysis of students' responses is needed to give empirical support to this speculation.

6. Conclusion

Findings of our study seemed congruent with the constructivist view that learning is an active and constructive process and students learn better in an interactive environment. From both students' comments and our observations we found that written assignments in an online course were similar to those in a traditional college course or a regular distance course, they were mostly of a private and solitary nature. In contrast, online discussion marked the major difference of an SLN online course from other types of courses. Online discussion was the public domain that students and the instructor came together to exchange ideas, negotiate meanings, construct multiple interpretations, and share diversified life experiences. The amount of interaction in the discussion could well influence students' perceptions of their learning experience. If there was a requirement of discussion but no grade percent assigned to it, nor clearly expressed quantity and quality requirements of contributions in the discussion, students might not take discussion seriously. As a result, their participation in discussion might gradually decrease. In contrast, if an instructor assigned a high percent of grade to participation in discussion and clearly expressed requirements of quantity and quality of contributions, students would put more efforts into reading and responding to other students' responses, which might result in better learning. As pointed out by Linda Harasim (1992), text-based communication facilitates learning; the reading and composing of text-based responses make students think critically about the concepts they are learning. Thus, we believe that varying degrees of emphasis on discussion might influence students' perceptions of the amount of learning occurred. Though this correlation should not be interpreted as a cause-effect relation, it has implication for instructional design of online courses. Since percent of grade weight and quantity and quality requirements can be controlled by the instructor, it is possible to adjust them to improve a course, though further empirical studies are needed to determine the optimal percent of grade weight and requirements of students' participation in discussion.

Finally, our findings showed the importance of the active participation of the instructor, while supporting the constructivist view that students learn through interaction with one another. Number of instructor's responses in discussion, although it had no statistical relation with students' perceived amount of learning, was closely related to number of students' responses. It seems that the more the instructor participated in the discussion, the more students were motivated to respond. Further research in this area could offer a solution to the dilemma that has been facing online instructors. On the on hand, online instructors fear that their voice might terminate a lively student-student discussion; on the other, their silence might be interpreted as an unresponsive attitude. It could also clear the misconception that since this is asynchronous distance learning, after an instructor has developed the course and launched it onto the World Wide Web, now it is students' turn to do all the work to learn: read offline and online, interact with fellow students online (if required), and submit written work online for instructor's evaluation. Our findings in this study and our daily observations of the courses revealed that student's active participation in a course relied to

some extent on the active participation of the instructor. An online instructor is more a conductor, a facilitator, and a manager than a deliverer of knowledge. Owing to the lack of face-to-face interaction, an instructor would very often require students to log on to the course and to contribute to the discussion to prove their "tangible existence". This is also true the other way around. Students want to know that their instructor is always there giving them support, scaffolding and guidance in the process of meaning construction. Level of students' involvement in an online course corresponds to the level of the instructor's involvement. This finding points to a new direction for our next step of research. A qualitative study of instructor's responses would reveal how an instructor should be involved in the discussion to achieve the best results.

Appendix A: Nineteen SLN Web-based courses offered in the spring of 1997

	Courses	Colleges	Level
1.	American Literature to the Civil War	two-year	Under/Lower
2.	Biology II	two-year	Under/Lower
3.	College Algebra	two-year	Under/Lower
4.	Contemporary Social Issues	four-year	Under/Upper
5.	English Composition	two-year	Under/Lower
6.	Entrepreneurship and Small Business Management	four-year	Under/Upper
7.	Human Resource Management	four-year	Under/Upper
8.	Interpersonal Conflict	four-year	Under/Upper
9.	Interpreting Statistics	two-year	Under/Lower
10.	Labor and Management Relations	four-year	Under/Upper
11.	Literature by Women	two-year	Under/Lower
12.	Management of Information Science	four-year	Under/Upper
13.	Marketing and Sales Promotion	four-year	Under/Upper
14.	Money and Banking	four-year	Under/Upper
15.	Political and Social Philosophy	four-year	Under/Upper
16.	Psychological Principles I	two-year	Under/Lower
17.	Psychology of Adjustment	four-year	Under/ Lower
18	Renaissance and Baroque Biography and Portraiture	four-year	Under/Upper
19.	Social Psychology	four-year	Under/Upper

Note:
Under/Lower = undergraduate at lower level
Under/Upper = undergraduate at upper level

Appendix B: Survey questions selected for the correlational analysis

The four questions selected from the survey are as follows:

1. Compared to other modes of learning, did you have more interaction with students in this course?
   A. more interaction with students in this course
   B. about the same amount of interaction with students in this course
   C. less interaction with students in this course

2. Compared to other modes of learning, did you have more interaction with your instructor in this course
   A. more interaction with your instructor in this course
   B. about the same amount of interaction with your instructor in this course
   C. less interaction with your instructor in this course

3. Compared to other modes of learning, do you think you have learned more in this course?
   A. considerably more in this course
   B. more in this course
   C. about the same amount in this course
   D. less in this course
   E. much less in this course

Appendix C. Demographic variables and students' perceptions of learning experience

Student	Gender	Age	Employ.	Inter/SS	Inter/IS	Am/I n
1	1	42	1	2	2	2
2	1	58	1	3	3	3
3	1	43	3	1	1	2
4	2	33	1	2	2	1
5	1	21	1	1	3	1
6	2	21	2	3	3	3
7	2	23	3	2	2	2
8	1	37	2	3	2	3
9	1	22	3	3	1	1
10	1	28	2	1	1	2
11	1	52	1	3	3	3
12	1	26	1	1	2	2
13	2	30	3	1	1	2
14	2	48	1	1	2	3
15	2	52	3	3	3	3
16	1	35	1	1	1	3
17	2	33	2	2	3	3
18	1	42	3	1	2	3
19	1	40	1	1	1	1
20	2	37	2	1	1	1
21	1	53	1	2	1	2
22	1	50	3	1	1	3
23	1	27	1	3	1	2
24	1	46	1	2	1	3
25	2	42	1	1	2	2
26	1	26	1	3	1	2
27	2	37	1	2	2	2
28	1	21	3	2	2	2
29	2	22	3	1	2	3
30	1	23	2	2	2	2
31	1	34	2	3	3	2
32	1	22	2	3	3	2
33	1	21	1	2	3	3
34	2	24	3	2	3	3
35	1	56	1	1	3	2

36	1	19	2	1	1	2
37	2	31	1	1	1	2
38	1	18	2	1	2	1
39	2	19	2	1	1	3
40	1	36	1	1	1	2
41	1	30	1	2	2	2
42	2	44	1	1	1	1
43	1	26	1	3	3	3
44	1	39	1	3	3	3
45	2	47	1	3	3	3
46	1	41	1	3	3	2
47	2	43	1	3	2	3
48	1	35	1	1	2	1
49	1	36	3	1	1	2
50	1	53	1	2	2	3
51	1	40	1	2	1	1
52	2	36	1	3	3	2
53	1	42	1	2	3	2
54	1	21	3	3	3	2
55	1	55	1	1	3	3
56	1	33	1	1	3	3
57	2	30	1	2	2	3
58	2	44	1	1	1	2
59	1	55	1	2	1	2
60	2	44	1	3	2	3
61	2	41	1	2	2	3
62	2	36	1	3	3	2
63	2	54	1	3	2	3
64	2	49	1	3	1	3
65	2	44	1	2	1	3
66	2	40	1	2	1	1
67	1	42	1	1	1	2
68	1	33	1	3	1	2
69	2	33	1	1	1	2
70	2	39	1	1	1	2

71	1	41	1	2	1	3
72	1	25	1	2	2	2
73	1	41	1	3	1	2
74	1	30	2	2	2	3
75	1	23	1	2	3	3
76	1	23	2	3	2	3
77	1	23	2	1	1	1
78	1	27	2	1	3	3
79	1	40	1	1	1	1
80	1	23	2	2	3	2
81	1	30	1	1	1	3
82	1	31	2	3	3	3
83	1	27	1	3	3	3
84	1	20	2	3	1	3
85	2	19	2	3	1	2
86	2	28	3	1	1	1
87	1	53	1	1	3	3
88	2	46	3	2	3	3
89	1	missing	2	3	3	3
90	1	21	2	1	2	2
91	1	22	2	2	2	2
92	1	23	2	1	2	2
93	1	44	3	3	3	3
94	1	23	3	3	3	3
95	1	37	1	3	3	3
96	2	42	1	2	1	3
97	2	20	2	1	3	2
98	2	25	2	2	3	3
99	1	30	1	3	3	3
100	2	26	2	2	3	2
101	1	31	3	2	2	3
102	2	36	1	1	2	3
103	1	25	2	2	2	3

Note:
Employ = Employment
Inter/SS = students' perceived degree of interaction with their fellow students
Inter/IS= students' perceived degree of interaction with their instructor
Am/l n = students' perceived amount of learning

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